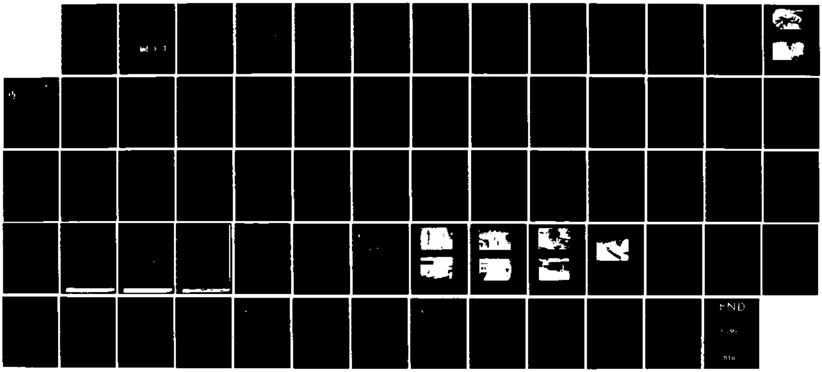
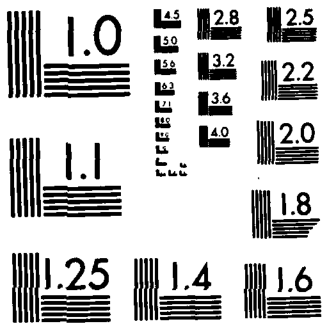
AD-A156 127 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS MERRIMACK VILLAGE DAM..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV FEB 79 1/1

UNCLASSIFIED F/G 13/13 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

AD-A156 127

MERRIMACK RIVER BASIN

MERRIMACK, NEW HAMPSHIRE

MERRIMACK VILLAGE DAM

NH 00115

NHWRB 156.01

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

FEBRUARY 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NH 00115	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Merrimack Village Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE February 1979
		13. NUMBER OF PAGES 48
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Merrimack, New Hampshire
Souhegan River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Tje da, os abput 180 ft. long and is constructed on a circular arc. It is small in size with a low hazard potential classification. THe dam is presently in fair condition. At the present time, there is no way to draw down the level of the reservoir. An institution of a program of annual technical inspections of the dam should be undertaken.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

MAY 29 1979

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

I am forwarding to you a copy of the Merrimack Village Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Pennichuck Water Works, 11 High Street, Nashua, New Hampshire 03060.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

MERRIMACK VILLAGE DAM
NH 00115

MERRIMACK RIVER BASIN
MERRIMACK, NEW HAMPSHIRE

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A/1	23

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

PHASE I REPORT

Identification No.:	NH 00115
NHWRB No.:	156.01
Name of Dam:	MERRIMACK VILLAGE DAM
Town:	Merrimack
County and State:	Hillsborough County, New Hampshire
Stream:	Souhegan River
Date of Inspection:	October 31, 1978

BRIEF ASSESSMENT

Merrimack Village Dam is approximately 180 feet long and is constructed on a circular arc. The original structure was a gravity stone masonry dam founded on bedrock and was built around 1907. In 1934 or thereabouts, the spillway was reconstructed to form an ogee type spillway of cyclopean concrete, and a concrete apron was added downstream. The height of the dam is approximately 20.5 feet while the height of the spillway is approximately 12 feet with a length of 145 feet ±. There are two 7 foot wide by 7 foot high sluice gates and a 10 inch pipe that act as outlet structures. The 10 inch pipe is used on a regular basis by the New England Chemical Company while the two sluice gates are inoperable.

The dam lies on the Souhegan River approximately 1700 feet upstream from the Merrimack River and is the last structure on the Souhegan River before it joins the Merrimack River. The drainage area of the dam is 171 square miles. The dam's maximum impoundment of 170 acre-feet places it in the SMALL size category with a hazard potential rated as LOW because of the remote possibility of loss of life and the minimal economic loss in case of failure.

Based on the size and hazard potential ratings in accordance with the Corps' guidelines, the Test Flood (TF) is in the range of the 50 to 100 year design flood. The 100 year TF yields a maximum discharge at the dam of approximately 12,500 cfs, which would result in a flow over the spillway on the order of 7.9 feet. However, this flow is still 0.2 feet below the low point at the right abutment and 0.6 feet below the crest of the dam.

The Merrimack Village Dam is presently in FAIR condition. The owner should retain the services of a registered professional engineer to determine the need for rehabilitating or sealing the sluice gates to make them structurally safe. In conjunction with this the adequacy of the downstream canal must be considered. At the present time, there is no way to draw down the level of the reservoir. Recommended remedial measures include repair of open joints on the spillway and right abutment structure, repair of horizontal joint and spalls in the left upstream training wall, repair of secondary gate structure, repair of spalls at vertical joint on left wall, and institution of a program of annual technical inspections of the dam.

The above recommendations and remedial measures should be implemented within one year of receipt of this report by the owner.

THE STATE OF NEW HAMPSHIRE
WILLIAM S. ZOINO
No. 3226
REGISTERED PROFESSIONAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
NICHOLAS ANTHONY CAMPAGNA, JR.
No. 21,006
CIVIL
STATE OF CALIFORNIA

William S. Zoino
N.H. Registration 3226

Nicholas A. Campagna, Jr.
California Registration 21006

This Phase I Inspection Report on Merrimack Village Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Joseph A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

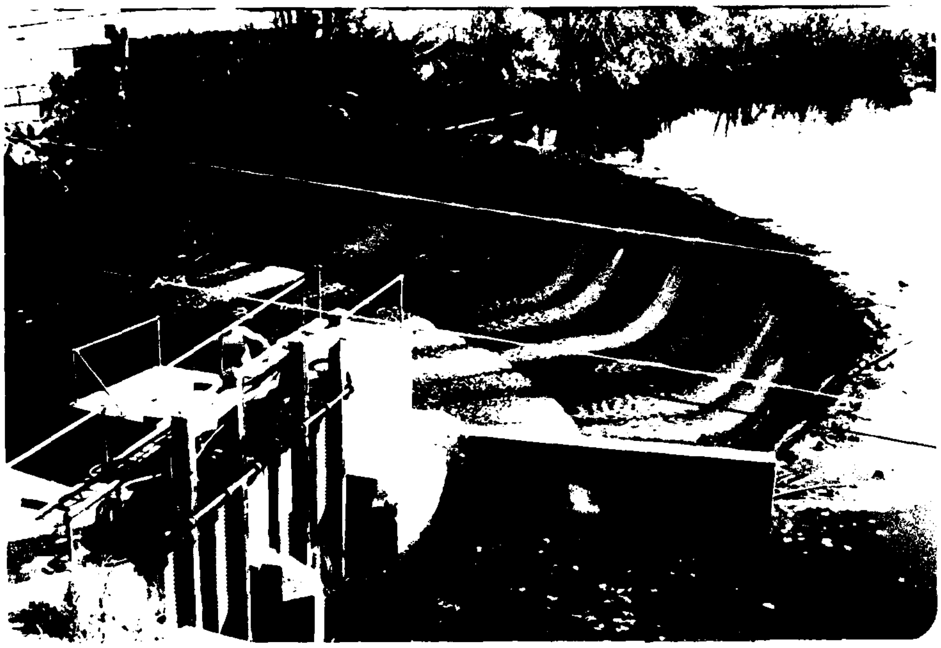
In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can unsafe conditions be detected.

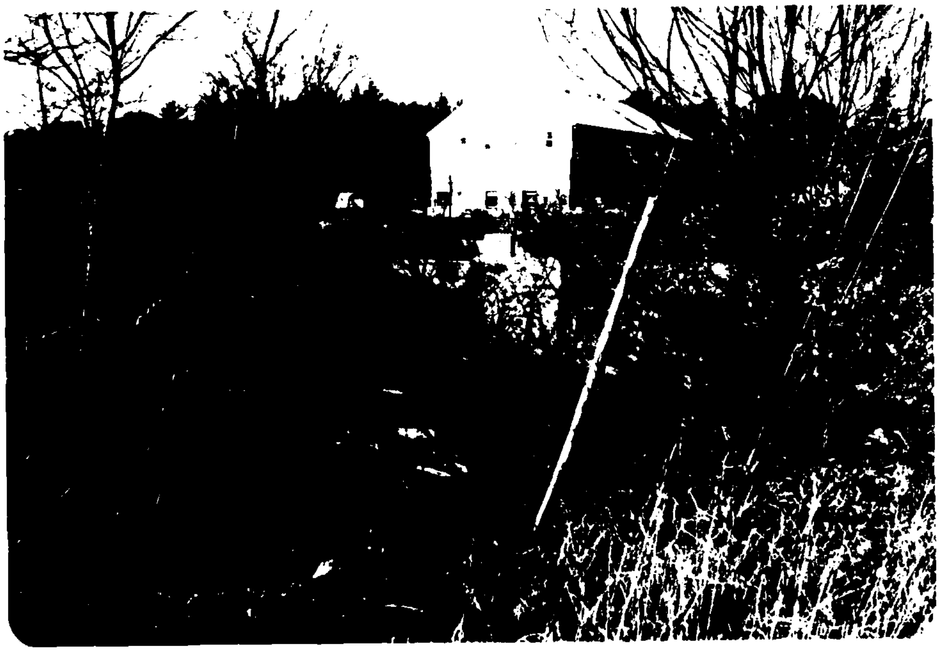
Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the Test Flood should not be interpreted as necessarily posing a highly inadequate condition. The Test Flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

Table of Contents - Cont.



Overview of dam from fire station
on left abutment



Overview of dam from right abutment

There are no operational regulating outlets for the dam. At the left end of the spillway, a concrete gate structure extends for another 31.5 feet to the bank. Two gates on this structure previously controlled flow into a 30 foot wide channel which provided a water power supply to an old mill or factory on the downstream side of Route 3. This channel is presently abandoned and sealed at the factory. A third gate at the dam controls flow through a 10 inch water supply pipe presently used to supply about 1.0 mgd to the New England Chemical Company.

Just downstream of the dam the river passes through a large arched bridge opening. The top of this opening is about four feet higher than the spillway crest. On the other side of the bridge, the river channel is confined between a high bank on one side and a high exterior wall of the old factory. Beyond this wall the present factory operation (New England Chemical Company) is located at a height of about 10 to 15 feet above the stream invert. A small pond about one acre in size is located just beyond the factory site and about 500 feet downstream of the dam. No development exists between this pond and the confluence with the Merrimack River less than one mile downstream.

(d) Overtopping Potential

The hydrologic conditions of interest in this Phase I investigation are those required to assess the dam's overtopping potential and its ability to safely allow an appropriately large flood to pass. This requires using the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. None of the original hydraulic and hydrologic design records are available for use in this study.

Guidelines for establishing a recommended Test Flood based on the size and hazard classification of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of less than 1,000 acre feet and the height of less than 40 feet classify this dam as a SMALL structure.

The hazard potential is LOW. At flows likely to cause failure, the failure of Merrimack Village Dam would make no significant difference in downstream flooding.

SECTION 5 - HYDRAULICS/HYDROLOGY

.1 Evaluation of Features

(a) Design Data

Data sources available for the dam include inventory reports, inspection reports, and a 1977 Flood Insurance Study (FIS) performed by Anderson-Nichols Company (ANCO). A 1907 watershed area map and Storage Elevation curve is also available. The New Hampshire Water Control Commissioners' "Data on Dams in New Hampshire" (March 28, 1939), the New Hampshire Water Resources Board's "Inventory of Dams and Water Power Developments" (October 29, 1935), and the Public Service Commission of New Hampshire's "Dam Record" (November 6, 1935) and "Dams in New Hampshire" (January 29, 1919) provide much of the basic data for the dam.

The ANCO FIS includes inflow calculations for the 10, 50, 100 and 500-year floods, cross-section data at various points on the Souhegan River (including the dam and the Route 3 bridge just downstream), and HEC-2 runs for the 10, 50, 100 and 500-year flows.

(b) Experience Data

USGS gauge 01094000 is located at Wildcat Falls approximately one mile upstream from the dam on the Souhegan River. Since the drainage area of this gauge is almost the same as that of the dam, the historic flows at the gauge are probably an accurate estimate of the flow at the dam. The gauge's record extends back to 1909, and the peak flow is an estimated 16,900 cfs on March 19, 1936.

(c) Visual Observations

The Merrimack Village Dam across the Souhegan River is an arched concrete structure just upstream of a highway bridge on U.S. Route 3. The spillway has an ogee-shaped section with an overall length of 145 feet with a crest elevation of 122.8 feet above Mean Sea Level. The spillway is about 12 feet high. At the time of the inspection, the water level behind the dam was approximately at the spillway crest with minimal flow being discharged. Little storage capacity is available in this run-of-the-river reservoir.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

There is no operational procedure for this dam. The only procedure performed at the dam is by New England Chemical Company personnel who once a year clean debris from in front of the sluice gates allowing water to leak into the canal. This floods the canal and thereby protects the 10-inch supply line from freezing.

4.2 Maintenance of Dam

No maintenance is performed at this dam.

4.3 Maintenance of Operating Facilities

No maintenance is performed on the operating facilities.

4.4 Description of Warning System

No formal warning system is in effect for this dam.

4.5 Evaluation

The dam's FAIR condition is a direct result of the lack of any maintenance being performed on the dam or its operating facilities.

(5) Canal Wall

The concrete overflow structure which forms the right wall of the canal is in fair condition. There is evidence of seepage over the entire base of the structure from the left abutment to the spandrel wall of the bridge. Surface erosion was observed over the entire length of its footing which is attributed to ice damage. A horizontal construction joint approximately 20 feet long has opened with efflorescence throughout the joint. Observations also revealed that random horizontal cracks and efflorescence occur over both faces of this structure. The top surface of this structure has spalls over approximately 5% of its surface area which is attributed to overtroweling of its surface.

(6) Left Retaining Wall

With the exception of spalling at three vertical joints in this wall, it is in good condition. The spalls noted are 8 to 10 feet high and are attributed to lack of expansion joints in this wall.

3.2 Evaluation

The Merrimack Village Dam is in FAIR condition. This is because of the condition of the sluice gates and the general deteriorated condition of the concrete of the various sections described previously. At the present time, there is no way to draw down the level of the reservoir.

This spalling is attributed to ice formation, moisture intrusion , and alternate freeze and thaw cycles. A weep hole opening is located at the base of the abutment downstream of the spillway which is approximately 1.5 feet wide and 0.5 feet high. Seepage through this weep hole is approximately 10 to 20 gpm. Chinking stones have been placed in the weep hole.

(3) Left Upstream Training Wall

This wall has a continuous construction joint with a high degree of efflorescence. In addition, there are surface cracks throughout this wall with associated efflourescence. At one location there is a spall approximately 18 inches long, 4 inches high, and one inch deep along this construction joint.

(4) Water Control Structure

The top surface of this structure has random and web cracking over its entire surface. This is attributed to moisture intrusion. The nosing of the intermediate pier upstream of the sluice gates has been subjected to erosion at the spillway crest level which can be attributed to ice damage. The balance of the exposed upstream and downstream faces of this structure are in good condition without evidence of cracks, spalls or efflourescence. Visual observations have revealed that the sluice gates are inoperable because of the advanced stage of deterioration. A rack gear is missing from the left side of the right gate. The right yoke of the left gate is rotted at approximately crest level. Seepage is prevalent through the gates. The operating mechanisms for both gates have not been maintained. A metal plate covers the upstream face of the right gate to control seepage. Debris has accumulated in front of the gates to within one foot below the crest elevation.

The secondary gate structure which houses the 10-inch gate valve is badly deteriorated This is attributed to poor quality concrete subjected to moisture intrusion and alternate freeze and thaw cycles. Reinforcing steel is exposed on its top surface.

The steel hand rail is in good condition.

SECTION 3 - VISUAL OBSERVATIONS

3.1 Findings

(a) General

The Merrimack Village Dam is in FAIR condition at the present time. This structure requires rehabilitation of the existing sluice gates to allow continued use.

(b) Dam

(1) Spillway

The spillway surface exhibits erosion which is attributed to cavitation and ice damage. A series of open horizontal joints, which are fairly uniform in elevation and are indicative of construction joints are also present. It should be noted that one horizontal joint located adjacent to the right abutment is approximately 2 inches wide and approximately 40 feet long. Observations revealed that the right hand end of this joint is at least 2 inches deep. Approximately 1 to 5 gpm of seepage was flowing through the three weep hole openings. Seepage of less than 0.05 gpm was observed at the joint between the spillway and the right abutment. The concrete apron downstream of the spillway is in good condition.

(2) Left Abutment

The cemented stone masonry foundation of the left abutment is in good condition, with the exception of 3 or 4 areas where seepage is flowing through the base of the masonry. The combined rate of seepage at these locations is less than 0.1 gpm. The mortared joints of this abutment are highly effloresced. The concrete capped section of this abutment over the cemented stone masonry is in good condition with the exception of a horizontal construction joint which has opened slightly with evidence of minor efflourescence at this joint. Furthermore, there is some evidence of spalling at the water line which is essentially the spillway crest elevation.

SECTION 2 - ENGINEERING DATA

2.1 Design Records

The design of this dam is relatively simple and with the exception of the arched spillway section, no unusual design features are present. None of the original design drawings or calculations are availble although a plan and section of the circa 1934 renovations was available. These drawings are found in Appendix B.

2.2 Construction Records

No construction records were available for the dam.

2.3 Operational Records

Because the dam no longer serves any real purpose the dam is no longer operated.

2.4 Evaluation

(a) Availability

The available data for this dam are limited and do not provide a good means of evaluating the dam. Therefore, an unsatisfactory evaluation for availability is warranted.

(b) Adequacy

The available information is not sufficient to permit an evaluation of the dam from the standpoint of reviewing design and construction data. An unsatisfactory assessment for adequacy is therefore warranted.

(c) Validity

What drawings are available are in general agreement with the as-built configuration of the dam. Thus, a satisfactory evaluation for validity is assigned.

(2) Storage - recreational pool: 85 acre-feet
- maximum pool: 170 acre-feet ±

(3) Surface area: maximum pool: 12 acres ±
recreational pool: 10 acres ±

(e) Dam

(1) Type: gravity stone masonry and concrete

(2) Length: 180 ft. ±

(3) Height: 20.5 ft. ±

(4) Top width: 4.5 ft.

(5) Side slopes: vertical on upstream face

(6) Cutoff, grout curtain - unknown

(f) Spillway

(1) Type: Concrete ogee gravity arch

(2) Length of weir: 145 ft.

(3) Crest elevation: 122.8

(4) U/S Channel: Full width of river

(5) D/S Channel: Full width of river

(g) Regulating Outlets

See paragraph (b) (1) of this section.

The drainage area for this gauge is reported as 171 square miles which is the drainage area used in the hydrologic analysis used herein.

(b) Discharge at Damsite

(1) Outlet Works

The only outlet works are the two 7 foot by 7 foot timber sluice gates and the 10 inch service line supplying water to the New England Chemical Company downstream from the dam. The two inoperable sluice gates have invert elevations of 114.8 while the 10 inch pipe has an invert elevation of 115 ±.

(2) Maximum Known Flood

USGS gauge 01094000 has been in place on the Souhegan River from 1909 to the present. The peak flow recorded by the gauge was approximately 16,900 cfs and occurred on March 19, 1936.

(3) Spillway Capacity at Maximum Pool Elevation:

12,900 cfs at El. 130.9; This also includes some flow over the right abutment (570 cfs)

(c) Elevation (ft. above MSL)

(1) Top of dam: El. 131.3

(2) Maximum pool design surcharge: El. 130.9 (Natural ground above right abutment)

(3) Recreational pool: El. 122.8

(4) Spillway crest: El. 122.8

(5) Streambed at centerline of dam: El. 110.5 ±

(6) Maximum tailwater: Unknown

(d) Reservoir

(1) Length - maximum pool: 2500 ft. ±
- recreational pool: 1500 ft. ±

(f) Operator

At present there is no one who operates the dam. The only operation of the dam consists of cleaning debris from in front of the inoperable sluice gates to allow water to leak through the sluice gates, thereby flooding the canal and protecting the 10 inch supply pipe from freezing. Mr. Steve Gorman, V.P. of Pennichuck Water Works (PWW), is responsible for the operation of the other dams owned by the PWW and can be reached at 603-882-5191. Since the sluice gates are not operable, there is no real operation that can be performed.

(g) Purpose of Dam

The original purpose of the dam was to provide power for downstream mills. However, it no longer serves this purpose. The only present purpose is to supply make-up water to a chemical plant.

(h) Design and Construction History

Available records do not indicate the date of construction of the original dam, however, the date 1907 is found on the gate structure. In 1916 the dam was raised by 1.5 feet. The last modifications occurred circa 1934 when the spillway was capped with cyclopean concrete to form an ogee spillway with a concrete apron. The latest modifications, in particular, were performed to improve the structural stability of the dam. The dam was originally used to supply an old mill located just downstream from the dam with water used for power generation.

(i) Normal Operational Procedures

There is no operational procedure for the dam. Since the sluice gates are not operable, there is no real operation that can be performed. Before cold weather sets in, representatives of the New England Chemical Company clean debris from in front of the sluice gates to allow leakage into the downstream canal, thereby flooding the canal and protecting the 10 inch water line from freezing.

1.3 Pertinent Data

(a) Drainage Area

USGS gauge 01094000 is on the Souhegan River at Wildcat Falls, about one mile upstream from the dam.

Remnants of the canal are in evidence on the downstream side of the bridge, however, because of the extensive amount of debris, the actual location of the present canal outlet is unknown.

The water control structure, which outlets into the canal, houses two 7 foot by 7 foot timber sluice gates divided by an intermediate concrete pier and nosing. The gated openings are 6 feet by 6 feet. There are no provisions for stop logs on the pool side of the gates. Both sluice gates are fabricated from timber and equipped with rack gears. The gates, which are not presently operable, have hand wheel controls which activate worm gear drive mechanisms.

The secondary intake structure houses a 10 inch gate valve for controlling discharge of process water to the New England Chemical Company located downstream of the bridge. This 10 inch supply line is located adjacent to the left canal wall.

(c) Size Classification

The dam's maximum impoundment of 170 acre-feet combined with its height of less than 40 feet, places the dam in the SMALL size category as defined in the "Recommended Guidelines."

(d) Hazard Potential Classification

At flows likely to cause failure of Merrimack Village Dam, the failure of the dam would make no significant difference in downstream flooding. Although significant damage would occur to Merrimack Village, the dam's failure would not increase the damage significantly, or present a serious threat of loss of life. For these reasons, a LOW hazard potential classification is warranted.

(e) Ownership

The Pennichuck Water Works owns the dam. The dam was purchased to obtain water rights for use in the supply of water to the city of Nashua, N.H. Pennichuck Water Works has offices at 11 High Street, Nashua, N.H., 03060.

1.2 Description of Project

(a) Location

The Merrimack Village Dam lies on the Souhegan River in Merrimack, N.H. The dam is located just upstream from the bridge which carries U.S. Route 3 over the Souhegan River in Merrimack. The dam is located approximately 1700 feet upstream from the confluence of the Souhegan and Merrimack Rivers. The portion of the USGS Nashua North, N.H. quadrangle presented on page viii shows this locus. Figure 1 of Appendix B is a site plan developed from the map and the site visit.

(b) Description of Dam and Appurtenances

The dam and appurtenances consist of an ogee type spillway structure, gate structure, and outlet canal. The original dam was a gravity stone masonry dam constructed on bedrock. At some later date, circa 1934, a cyclopean concrete ogee spillway was constructed over the old spillway with the concrete apron also being added at that time.

The dam is approximately 180 feet long and is constructed on an arc across the Souhegan River. The left end of the spillway connects into an abutment and water control structure. The right end of the spillway abuts bedrock adjacent to the cemented stone masonry spandrel wall of the arch bridge carrying Route 3 over the Souhegan River. There are three weep hole openings approximately 12 inches wide by 24 inches high located at the quarter points of the spillway base.

The left end of the spillway terminates at a concrete-capped cemented stone masonry abutment approximately 14 feet upstream of a water control structure. The water control structure, which is a continuation of the left abutment to the left bank, is approximately 34 feet long. A 15 foot training wall is located on the upstream left bank. This training wall connects to a secondary intake structure which is monolithically cast with the water control structure. The water control structure houses two sluice gates which discharge into an abandoned canal adjacent to the existing spillway but is separated by a structure which is located normal to the axis of the water control structure. The canal passes under the highway through a secondary stone arch bridge.

PHASE I INSPECTION REPORT

MERRIMACK VILLAGE DAM

SECTION 1

PROJECT INFORMATION

1.1 General

(a) Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed was issued to GZD under a letter of November 28, 1978 from Colonel Max B. Scheider, Corps of Engineers. Contract No. DACW 33-79-C-0013 has been assigned by the Corps of Engineers for this work.

(b) Purpose

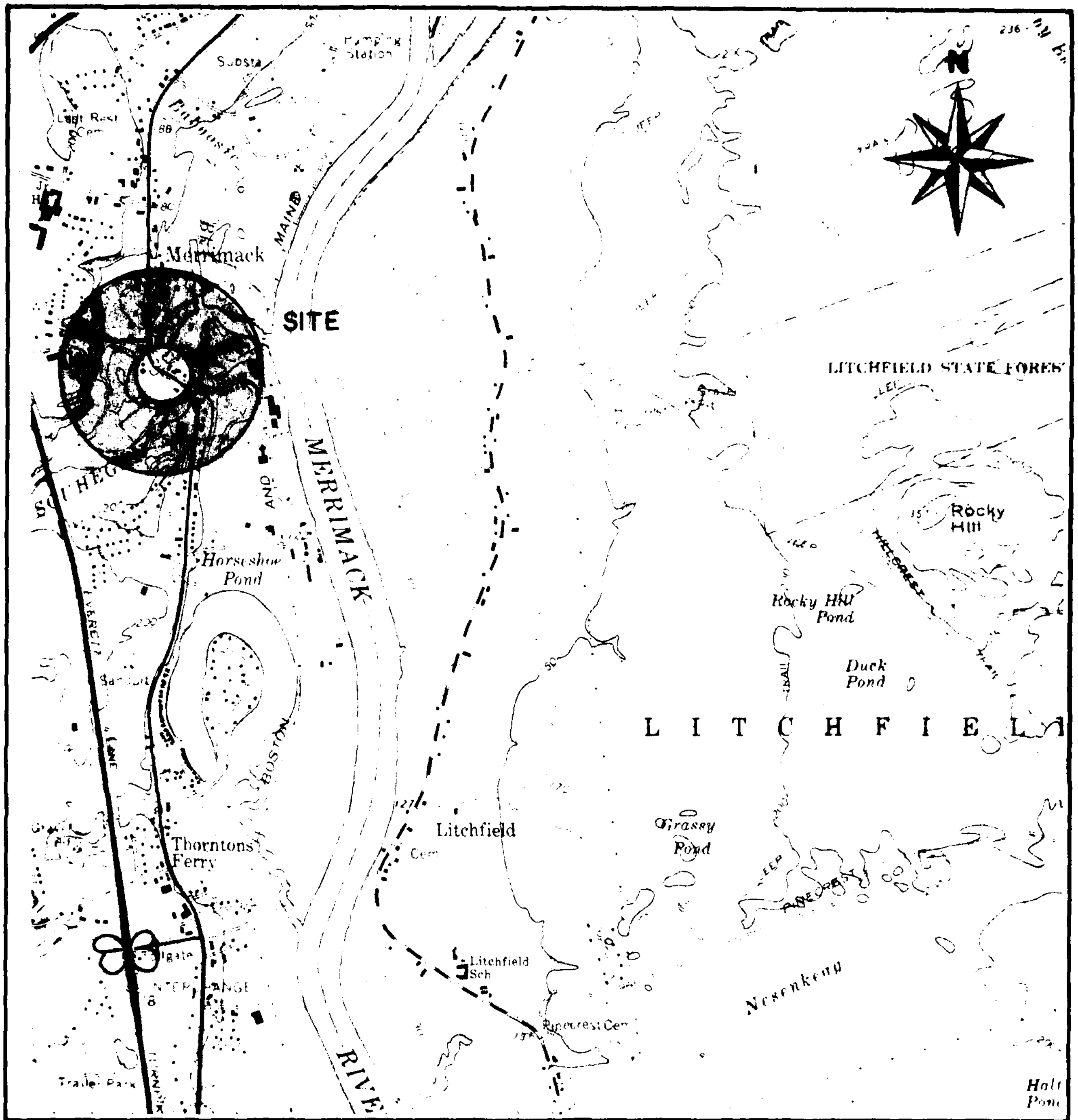
(1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

(2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

(3) Update, verify, and complete the National Inventory of Dams.

(c) Scope

The program provides for the inspection of non-federal dams in the high hazard potential category based upon location of the dams and those dams in the significant hazard potential category believed to represent an immediate danger based on condition of the dam.



- SCALE -

0 1000 2000 4000 FT.

FROM: USGS NASHUA NORTH, N.H. QUADRANGLE MAP

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC. GEOTECHNICAL CONSULTANTS NEWTON UPPER FALLS, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCUS PLAN

FILE No. 2201

MERRIMACK VILLAGE DAM — NEW HAMPSHIRE

SCALE AS NOTED

DATE OCTOBER 1978

Although flows likely to cause dam failure would result in significant damage to Merrimack Village, the dam's failure would not increase the damage significantly, or seriously threaten loss of life.

As shown in Table 3 of theCorps of Engineers' "Recommended Guidelines," the appropriate Test Flood for a dam classified as SMALL in size with a LOW hazard potential would be between the 50 and 100-year flows. ANCO's FIS gives a fifty-year flow of 11,900 cfs and a 100-year flow of 12,500 cfs. The peak recorded flow is 16,900 cfs.

Because of small storage of the pond and the high flows considered, the storage would not attenuate the peak flow noticeably. The peak discharges and stages for the 50-year, 100-year and peak historical floods may be compared as follows:

Event	Peak Discharge (cfs)	Peak Elevation (ft MSL)	Head Above Spillway (feet)	Head Above Dam Crest (feet)
50-year	11,900	130.5	7.7	-0.4
100-year	12,500	130.7	7.9	-0.2
Estimated Historical Maximum	16,900	132.2	9.4	1.3

Since the hazard potential is on the high side of LOW, we will use the 100-year flood as a Test Analysis Flood. The peak elevation would be 7.9 feet above the spillway, still 0.2 feet below the natural ground at the right abutment and 0.6 feet below the crest of the dam.

5.2 Hydrologic/Hydraulic Evaluation

Although this dam was probably significantly overtopped by the flood record, in 1936, it does not appear that the overtopping resulted in appreciable structural damage to the dam. Since the dam has survived a flow significantly greater than the applicable Test Flood flow and since the calculations indicate that the Test Flood flow would not overtop the dam, the spillway capacity appears to be adequate. Even if the dam were to fail, it is unlikely that the failure would significantly increase downstream flooding.

5.3 Downstream Dam Failure Hazard Estimates

The peak outflow that would result from the failure of Merrimack Village Dam is estimated using the procedure suggested in the Corps of Engineers New England Division's April 1978 "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs," as clarified in a December 7, 1978 meeting. Failure is assumed to occur with the water surface elevation at the top of the natural ground above the right abutment, 8.1 feet above the spillway crest (elevation 130.9).

To determine the normal discharge at this stage, refer to the Stage-Discharge curve in Appendix D. This curve sums discharge over the spillway and the dam crest. The calculations determining this curve are shown in Appendix D.

The normal discharge with h = 8.1 is 12,900 cfs. With a 58 foot gap in the dam and tailwater 1.1 feet above spillway level, the peak failure outflow would be about 14,700 cfs. This flow is close to ANCO's 100-year flow of 12,500 cfs, and would probably pass under the Highway 3 bridge just downstream of the dam without overtopping the bridge.

Under high flow conditions just before overtopping, the downstream depth of flooding above the channel invert is estimated to be about 24 feet (10 feet above the wall on the south bank). This would probably cause significant damage to the factory and other structures. The peak failure outflow of 14,700 cfs would increase the water surface elevation by about 2 feet, to 26 feet above the channel invert and 12 feet above the wall. This would not be a significiant increase to the existing flooding and would pose little threat of loss of life since evacuation of the area would already have occurred because of the existing flooding.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

(a) Visual Observations

The field investigation revealed no signficiant displacement and/or distress which would warrant the preparation of structural stability calculations based on assumed sectional properties and engineering properties.

(b) Design and Construction Data

No plans or calculations of value to a stability assessment are available for this dam.

(c) Operating Records

No operating records are available for this dam since no operation of the dam is performed.

(d) Post Construction Changes

The numerous alterations conducted during the lifetime of this dam did improve the structural stability of this dam.

(e) Seismic Stability

The dam is located in Seismic Zone No. 2 and, in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

(a) Condition

The Merrimack Village Dam is in FAIR condition at the present time.

(b) Adequacy of Information

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment is based primarily on the visual inspection, past performance, and sound engineering judgment.

(c) Urgency

The recommendations and improvements contained herein should be implemented by the owner within one year of this Phase I report.

(d) Need for Additional Investigations

Additional investigations should be performed by the owner as outlined in Paragraph 7.2 below.

7.3 Recommendations

It is recommended that the owner retain the services of a registered professional engineer to determine the necessity for rehabilitating or sealing the sluice gates and making them structurally safe. In conjunction with this study the adequacy of the downstream canal must be considered.

7.3 Remedial Measures

The Merrimack Village Dam requires considerable maintenance type repairs to allow its continued use in future years. These measures include:

(a) Repair the open joints on the spillway surface and the right abutment structure to slow further deterioration.

(b) Repair the horizontal joint in left abutment.

(c) Repair the horizontal joint and spalls on the left upstream training wall.

(d) Repair the secondary gate structure.

(e) Repair the spalls at vertical joints on the left wall.

(f) Institute a program of annual technical inspections of the dam.

7.4 Alternatives

An alternative to the above recommendations is to continue operations under the present conditions recognizing that failure of the dam will inevitably occur under these conditions. This alternative would require a detailed study of the consequences of a dam failure under various flood conditions. This would only be a viable alternative if little or no damage to structures or loss of life would result from a failure.

Another alternative is to breach the dam. The major problem with this alternative is that the New England Chemical Company has water rights of 1.0 mgd from the dam. A solution of this problem would be required prior to breaching the dam.

APPENDIX A

VISUAL INSPECTION CHECKLIST

INSPECTION TEAM ORGANIZATION

Date: October 31, 1978

NH 00115
MERRIMACK VILLAGE DAM
Merrimack, New Hampshire
Souhegan River
NHWRB 156.01

Weather: Clear, 50°F

INSPECTION TEAM

Nicholas Campagna	Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD)	Team Captain
William Zoino	GZD	Foundations
Robert Minutoli	GZD	Soils
Andrew Christo	Andrew Christo Engineers (ACE)	Structural
Paul Razgha	ACE	Concrete
Richard Laramie	Resource Analysis, Inc.	Hydrology

The inspection team was accompanied by the following:

Jack Collins	Pennichuck Water Works (PWW)
Gus Grikas	PWW
Pattu Kesavan	New Hampshire Water Resource Board

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	**BY**	**CONDITION & REMARKS**
DAM SUPERSTRUCTURE		
A. General		
Vertical alignment and movement	AC	No deficiencies noted
Horizontal alignment and movement		No deficiencies noted
B. Left Abutment		
Condition of stone masonry		Mortar joints highly efflour-escenced
Condition of concrete		Fair
Spalling		Minor spalling at spillway crest elevation
Cracking		Horizontal joint at interface with the stone masonry opened with minor efflourescence
Rusting or staining of concrete		None noted
Efflourescence		None noted
Visible reinforcing		None noted
Seepage		Seepage flowing through the base of the stone masonry at the combined rate of less than 0.1 gpm
C. Left Upstream Training Wall		
Condition of concrete		Fair
Spalling	AC	Horizontal spall at construction joint 4" wide x 18" long x 1" deep

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Cracking	AC	Random surface cracking over entire wall face
Rusting or staining of concrete		None noted
Visible reinforcing		None noted
Seepage		None noted
Efflourescence		High degree of efflourescence along entire length of horizontal construction joint
D. Right Abutment		Spillway ties into bedrock; minor seep (less than .05 gpm) at concrete-bedrock interface, 4-1/2 feet below top of spillway
OUTLET WORKS		
A. Spillway And Downstream Apron		
Condition of concrete		Minor surface erosion
Spalling		None noted
Cracking		Horizontal construction joints opened. Joint adjacent to right abutment 40' long, 2" wide and 2" deep
Rusting or staining of concrete		None noted
Visible reinforcing		None noted
Seepage	AC	Active seepage at the rate of 1 to 5 gpm through weep drains

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
B. Water Control Structure		
Condition of concrete	[illegible]	Good
Erosion		Minor erosion of upstream pier nosing at the spillway crest elevation
Cracking		Random and web cracking over entire platform surface
Rusting or staining of concrete		None noted
Visible reinforcing		None noted
Efflourescence		None noted
Seepage		Seepage through weep drain 10 to 20 gpm (see dual sluice gates also)
Steel hand rail		Good
Dual sluice gates		Frames partially rotted. Approximately 25 to 50 gpm seepage through and around gates. Both gates are inoperable. Approximately 8 feet of debris and silt behind gates. Operating mechanisms not maintained and cannot be operated in their present condition
C. Secondary Gate Structure		
Condition of concrete		Poor
Spalling		Entire top surface spalled
Cracking	[illegible]	Sidewalks exhibit random cracking

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Rusting or staining of concrete		None
Visible reinforcing		Top reinforcing steel exposed and rusted
Efflourescence		Exposed surfaces highly efflourescenced
Gate operation		Owner's representative indicated that gate valve is operable
D. Outlet Canal		
Bottom conditions		Heavy growth of grass and weeds
Right Downstream Wall		
Condition of concrete		Fair
Cracking		Horizontal construction joint opened, 20 feet long. Random horizontal cracks
Rusting or staining		None noted
Visible reinforcing		None noted
Seepage		Observed over entire base of the structure from canal to river channel
Efflourescence		Located on open horizontal construction joint and all longitudinal cracks
Left Retaining Wall		
Condition of concrete		Good
Spalling		Spalls at 3 vertical construction joints 8' to 10' high

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Cracking	AC	None noted
Rusting or staining		None noted
Visible reinforcing		None noted
Seepage or effloures-cence	AC	None noted
RESERVOIR		
A. Shoreline		
Evidence of slides	NAC	None noted
Potential for slides		Shoreline stable
B. Sedimentation		At least 8 feet of debris and silt behind sluice gates
C. Upstream hazard areas in the event of back-flooding		None noted
D. Changes in nature of watershed (agriculture, logging, construction, etc.)	NAC	None noted
DOWNSTREAM CHANNEL		
Concrete apron	AC	Minor surface erosion
Trees overhanging channel	NAC	None of significance
Floor of channel	NAC	Rocky with bedrock exposures

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
OPERATION AND MAINTENANCE FEATURES		
A. Reservoir regulation plan		
Normal procedures	NAC	No operations are presently performed to control reservoir level
Emergency procedures		None
Compliance with designated plan		No plan exists
B. Maintenance		
Quality		Many maintenance repairs needed
Adequacy	NAC	Situation indicates a more rigorous program needed

APPENDIX B

For h = 8.1 to 8.5

$Q_1 = 2.8\,(h-8.1)(20)(.5(h-8.1))^{3/2}$

$Q2 = 2.8(50)(h-8.1)^{3/2}$

all others unchanged

Broad-crested earth weir $\rightarrow C = 2.8$

For h > 8.5

$Q_5 = 2.8(615)(h-8.5)^{3/2}$

$Q_6 = 2.8\ (100)(h-8.5)(.5(h-8.5))^{3/2}$

all others same

Broad-crested earth weir $\rightarrow C = 2.8$

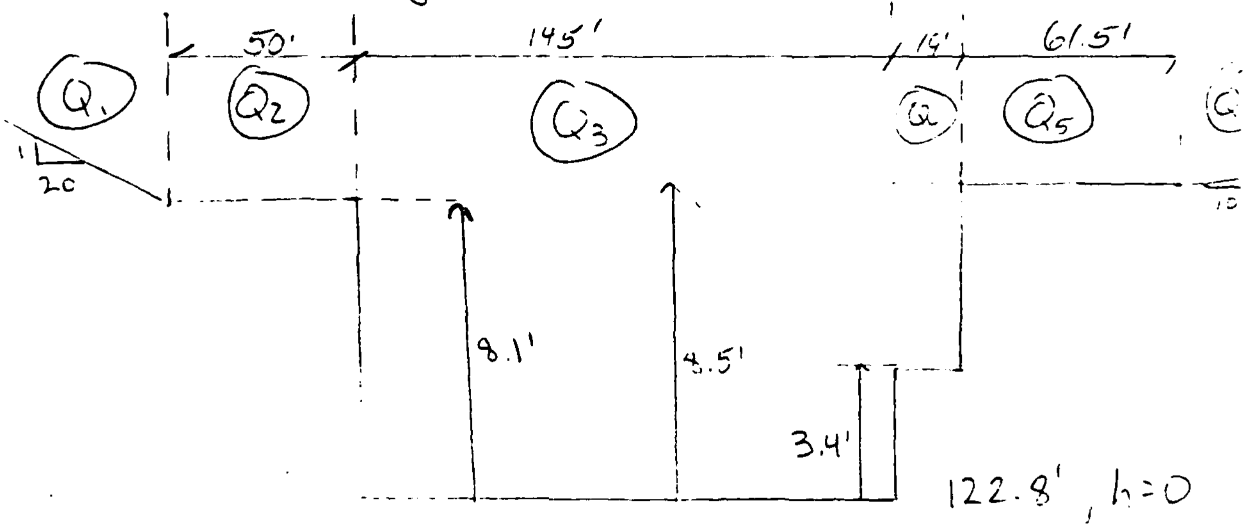
The Basic program which follows calculates the Stage-Discharge curve at the dam.

Note: For high stages (& flows) tailwater submergence of the spillway will begin to decrease the flow over the spillway at a given head. In the elevations considered (up to h = 9.5), this is not a major problem.

It is also worth note that at very high flows the dam will become submerged in the backwater from the Highway 3 Bridge just downstream and will cease to control flow.

Stage - Discharge Curve

The information used to establish the cross-section at Merrimack Village Dam was determined from field notes



There are two outlets from Merrimack Village Dam:

① Two 8' X 7' gates with inverts at 114.8'. These are inoperable.

② One 10" pipe with its invert at ~ 115.0. This is used to divert water for the Northeast Chemical Company. The flow through this pipe is negligible at flows of interest and will be ignored in our Stage - Discharge Calculations.

for h = 0 to 3.4

$$Q_1 = Q_2 = Q_4 = Q_5 = Q_6 = 0$$

$$Q_3 = 3.7\,(145)\,(h)^{3/2}$$

Q_3 is over an ogee spillway use $C = 3.7$

for h = 3.4 to 8.1

$$Q_4 = 3.3\,(19)\,(h-3.4)^{3/2}$$

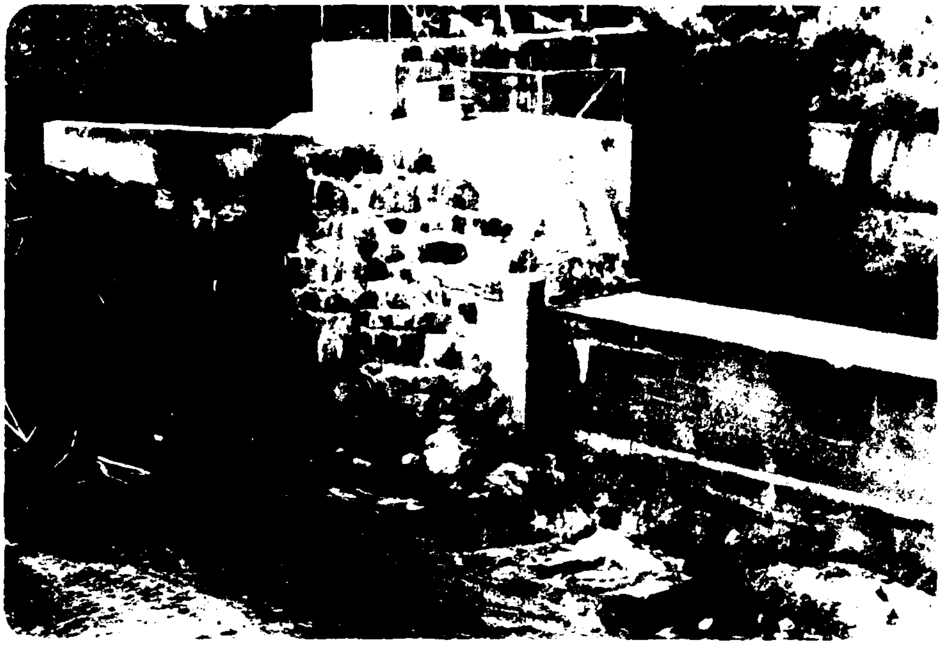
all others unchanged

Q_4 is over a sharp-crested weir → $C = 3.3$

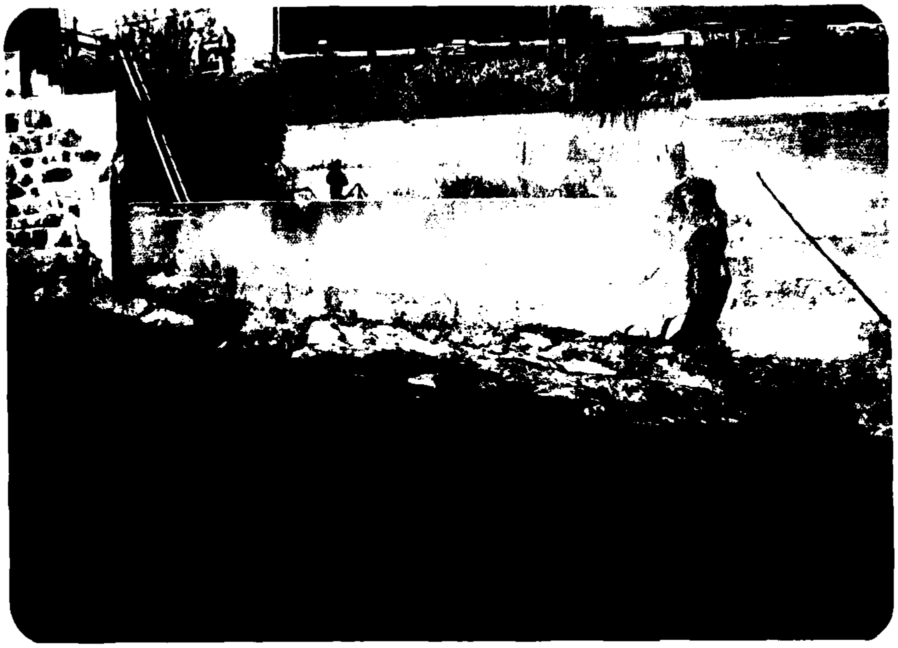
APPENDIX D

HYDROLOGIC/HYDRAULIC COMPUTATIONS

7. View of highway bridge just downstream of dam and of the diversion channel to old mill



5. View from downstream channel showing voids and seepage at base of cemented rubble stone masonry and showing temporary debris

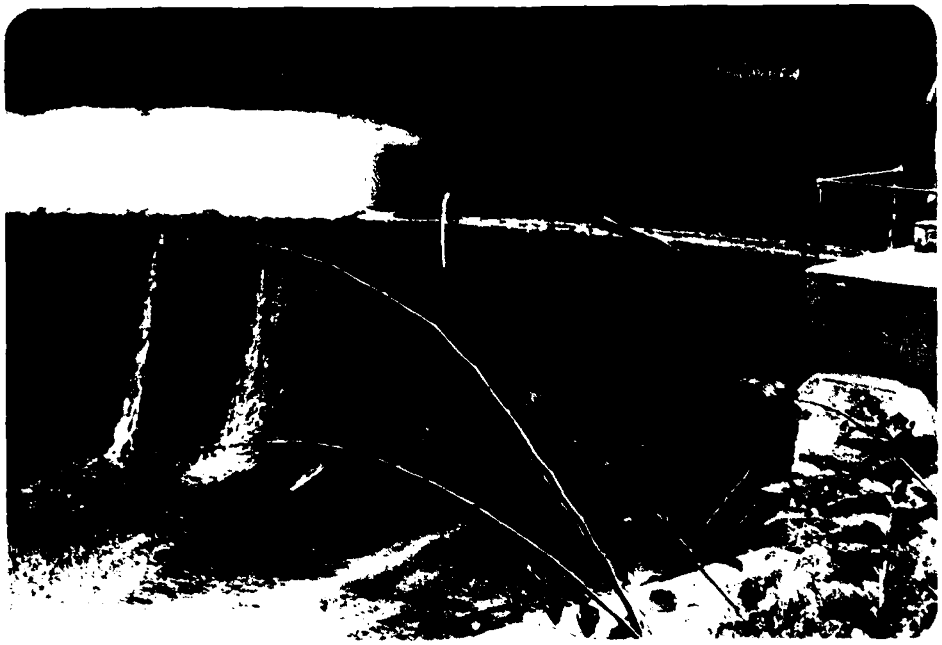


6. View of deterioration of concrete and seepage at base of diversion channel wall from the downstream channel

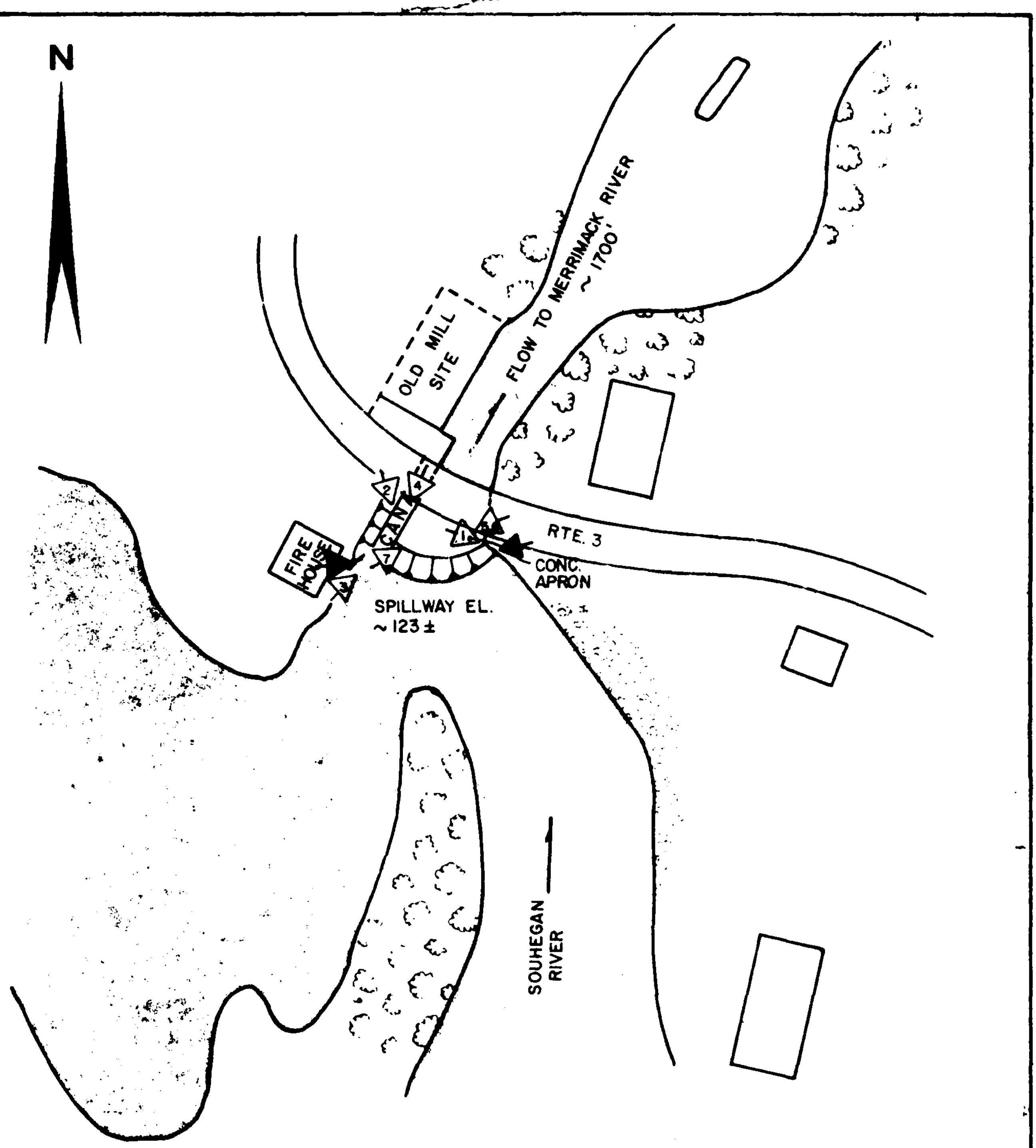
3. View from upstream left side of gate structure

4. View from highway bridge showing downstream face of gate structure and wooden sluice gates

1. View of right abutment from downstream channel



2. View of spillway from left side of downstream channel showing horizontal cracks and flow through pressure relief openings at the toe



OVERVIEW

APPENDIX C

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC. GEOTECHNICAL CONSULTANTS NEWTON UPPER FALLS, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND ORIENTATION OF PHOTOS

FILE No. 2201

MERRIMACK VILLAGE DAM — NEW HAMPSHIRE

SCALE 1" ≈ 200'

DATE OCTOBER 1978

APPENDIX C

SELECTED PHOTOGRAPHS

List of Pertinent Data Not Included in This Report

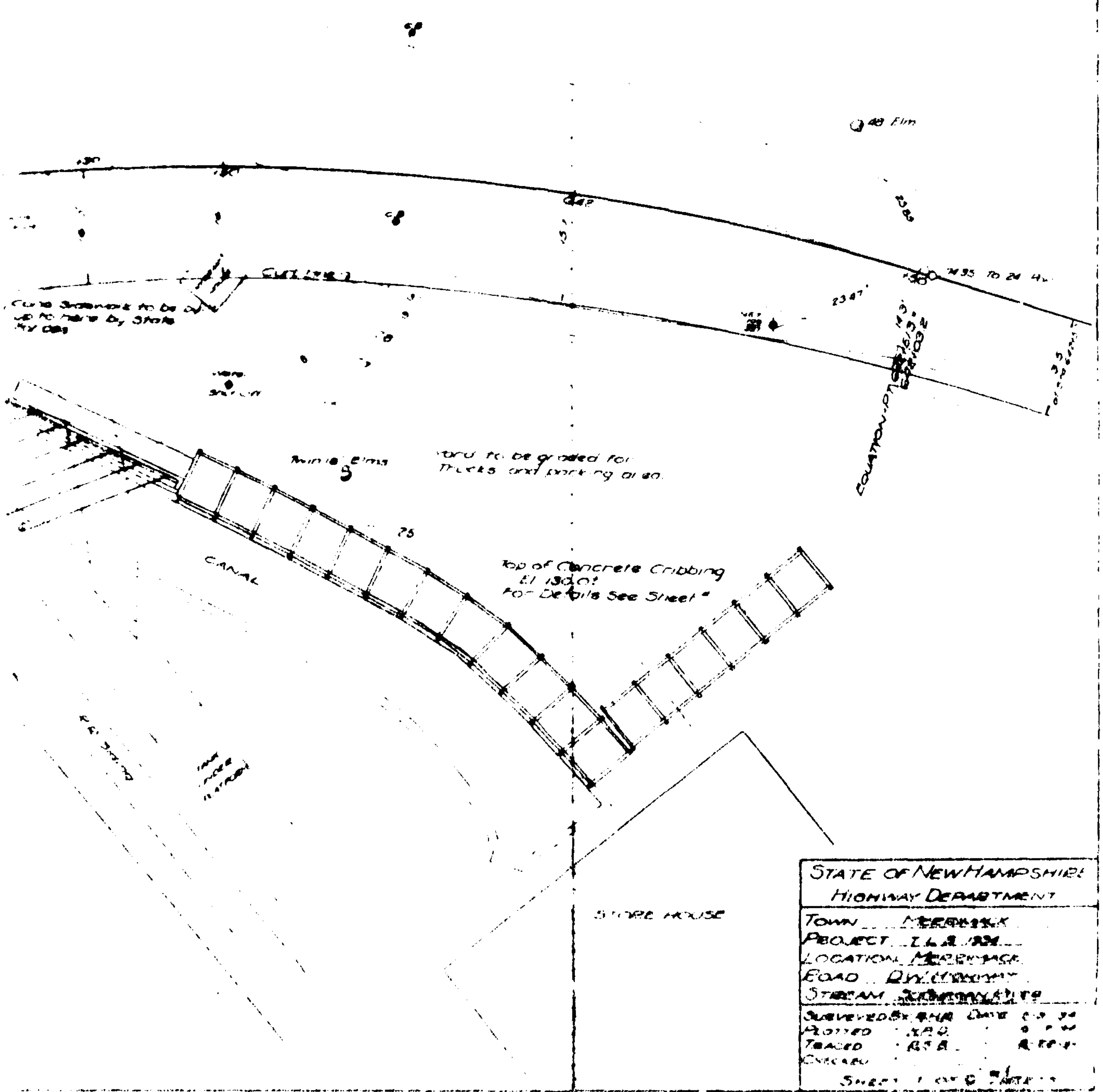
The New Hampshire Water Resources Board (NHWRB) maintains a comprehensive correspondence file for the Merrimack Village Dam. Some of the pertinent data contained in the file is listed below.

1. A 1975 letter from NHWRB to Pennichuck Water Works describing repairs that need to be made at the dam.

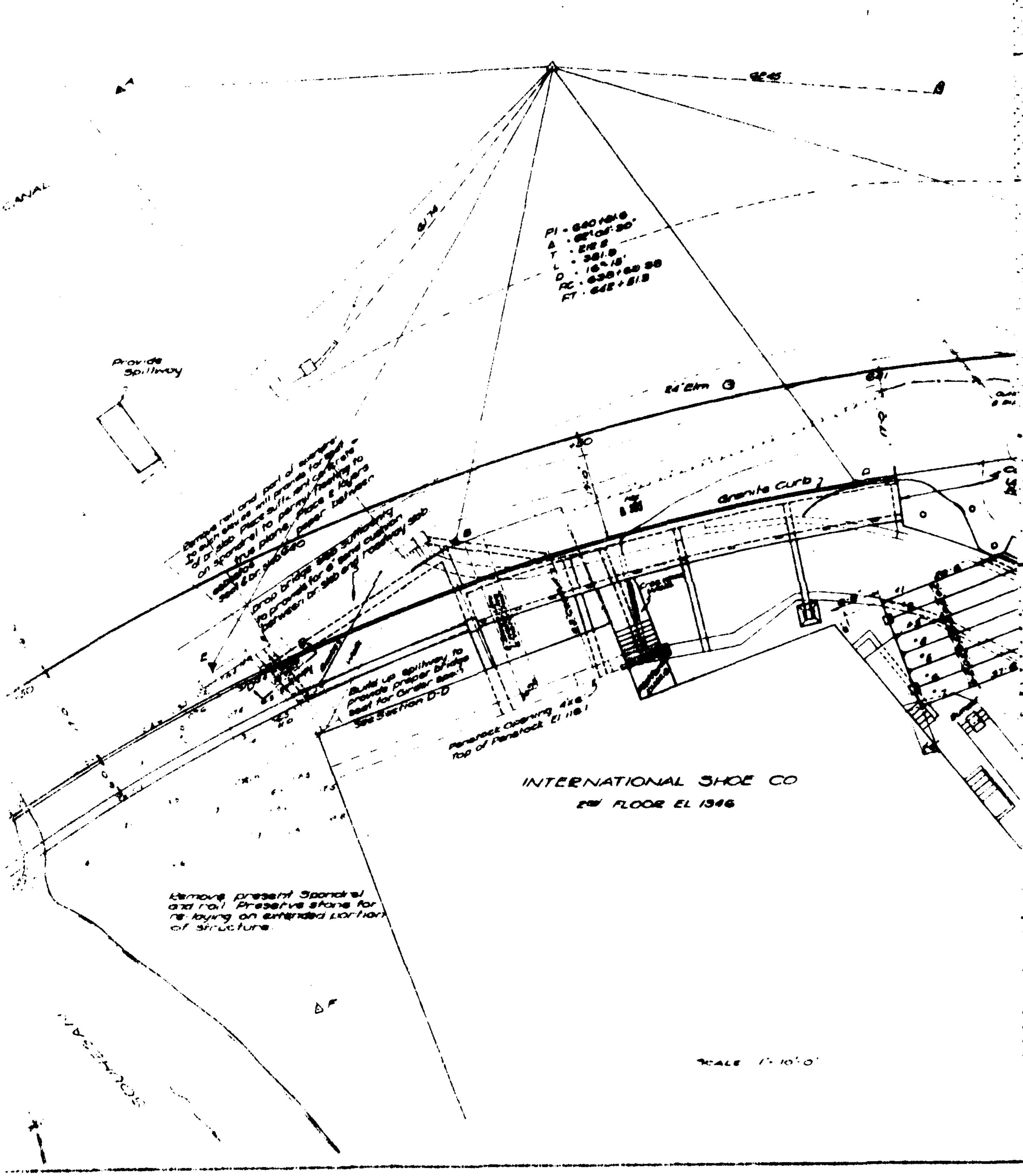
2. Several inspection reports performed by NHWRB and the New Hampshire Water Control Commission.

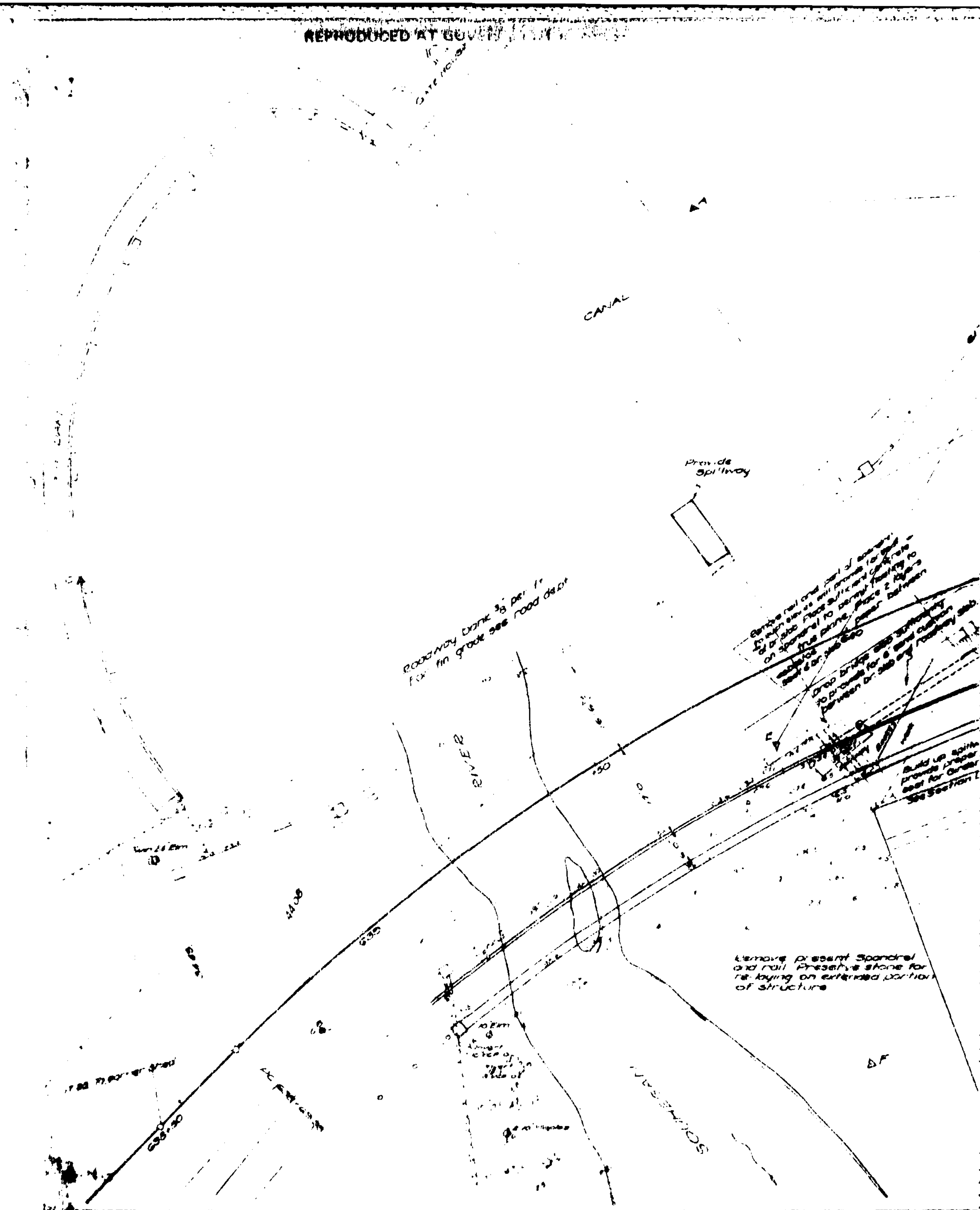
3. Inventory reports of the New Hampshire Water Control Commission and the NHWRB.

4. A questionnaire from the New Hampshire Public Service Commission on the proposed changes to the dam circa 1934.

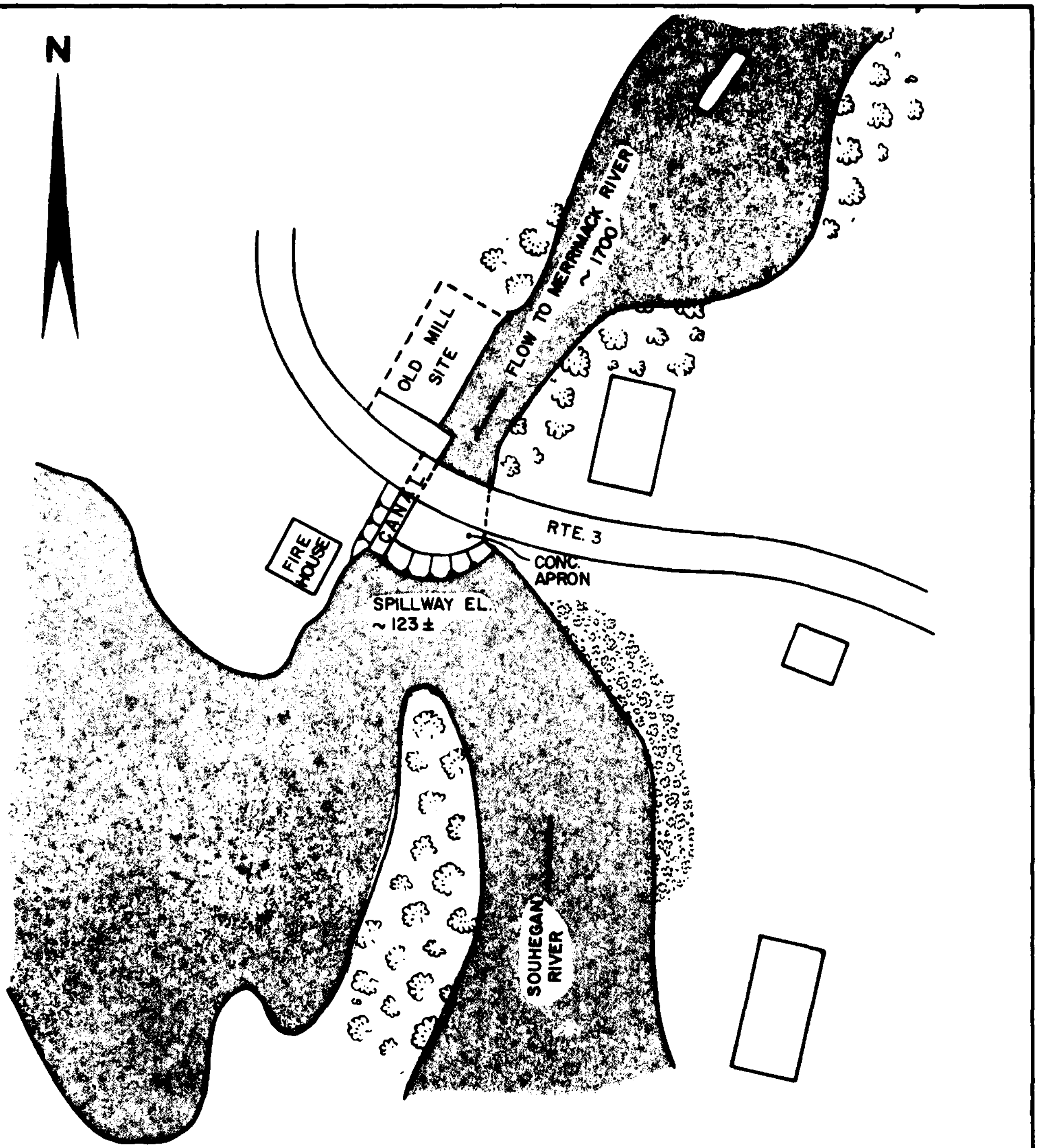

48 Elm
Twin 18" Elms
to be graded for
Trucks and parking area
CANAL
Top of Concrete Cribbing
El 130.0±
For Details See Sheet #
EQUATION
STORE HOUSE
STATE OF NEW HAMPSHIRE
HIGHWAY DEPARTMENT
TOWN
PROJECT
LOCATION
ROAD
STREAM
SURVEYED BY
PLOTTED
TRACED
CHECKED

(3)


CANAL
Provide Spillway
Granite Curb
INTERNATIONAL SHOE CO
Remove present Spandrel and rail. Preserve stone for re-laying on extended portion of structure.


CANAL
Provide
Spillway
Roadway bank 3/8 per ft
For fin grade see road dept
RIVER
Remove present Spandrel
and rail. Preserve stone for
re-laying on extended portion
of structure
Drop bridge slab sufficiently
to provide for a sand cushion
between br. slab and roadway slab
Build up spillw
provide proper
seat for Girder
See Section

(1)



GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SITE PLAN

FILE No. 2201

MERRIMACK VILLAGE DAM — NEW HAMPSHIRE

SCALE 1" = 200'

DATE OCTOBER 1978

P. 3

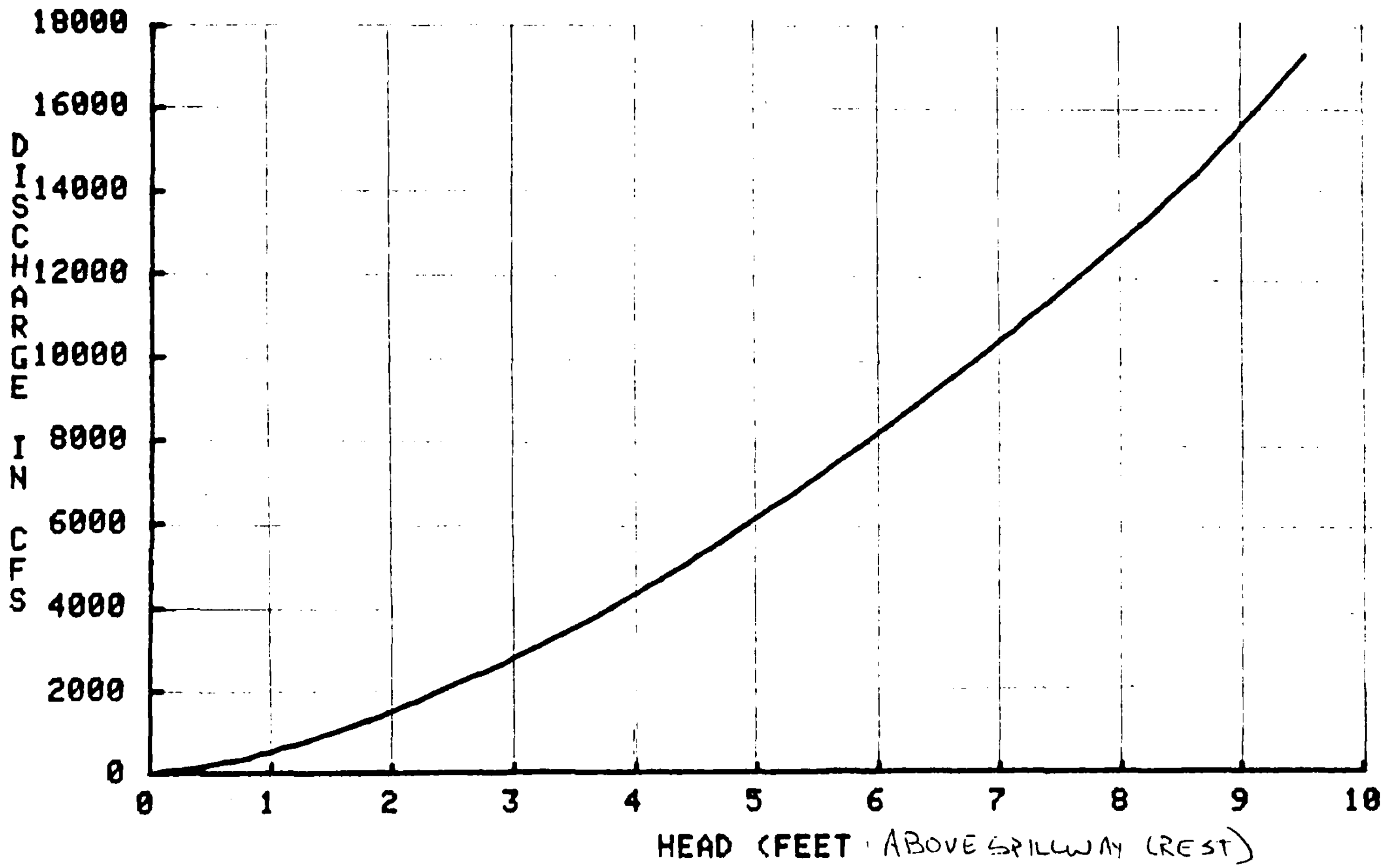
```
LIST
100 REM: STAGE DISCHARGE PROGRAM FOR MERRIMACK VILLAGE DAM, JOB 165
110 REM: ON TAPE 10, FILE 55
120 PAGE
130 PRINT "DISCHARGE FROM MERRIMACK VILLAGE DAM AS A FUNCTION OF HEAD"
140 PRINT USING 150:
150 IMAGE // 2T"HEAD"30T"DISCHARGE"
160 PRINT USING 170:
170 IMAGE 1T"(FEET)"32T"(CFS)"/
180 PRINT USING 190:
190 IMAGE 15T"TOTAL"8X"LEFT BANK"8X"RIGHT BANK"8X"SPILLWAY"//
200 FOR H=0 TO 9.5 STEP 0.5
210 Q1=0
220 Q2=0
230 Q4=0
240 Q5=0
250 Q6=0
260 Q3=3.7*145*H↑1.5
270 IF H<=3.4 THEN 350
280 Q4=3*19*(H-3.4)↑1.5
290 IF H<=8.1 THEN 350
300 Q2=2.8*50*(H-8.1)↑1.5
310 Q1=2.8*(20*(H-8.1))*(0.5*(H-8.1))↑1.5
320 IF H<=8.5 THEN 350
330 Q5=2.8*61.5*(H-8.5)↑1.5
340 Q6=2.8*100*(H-8.5)*(0.5*(H-8.5))↑1.5
350 T1=Q1+Q2
360 T2=Q4+Q5+Q6
370 T3=T2+Q3+T1
380 PRINT USING 390:H,T3,T1,T2,Q3
390 IMAGE 2T,2D.1D,14D,15D,18D,17D
400 NEXT H
410 END
```

D.4

DISCHARGE FROM MERRIMACK VILLAGE DAM AS A FUNCTION OF HEAD (Above Spillway Crest)

HEAD (FEET)	DISCHARGE (CFS) TOTAL	LEFT BANK	RIGHT BANK	SPILLWAY
0.0	0	0	0	0
0.5	190	0	0	190
1.0	536	0	0	536
1.5	986	0	0	986
2.0	1517	0	0	1517
2.5	2121	0	0	2121
3.0	2788	0	0	2788
3.5	3515	0	2	3513
4.0	4318	0	26	4292
4.5	5187	0	66	5121
5.0	6114	0	115	5998
5.5	7094	0	173	6920
6.0	8124	0	239	7885
6.5	9202	0	311	8891
7.0	10325	0	389	9936
7.5	11493	0	473	11019
8.0	12702	0	562	12140
8.5	13989	37	656	13295
9.0	15454	135	834	14485
9.5	17117	278	1130	15709

STAGE-DISCHARGE CURVE AT MERRIMACK VILLAGE DAM



P. 5

DAM FAILURE ANALYSIS

Assume that the dam fails with the water surface at the crest on the left side, at h=8.1 (elevation 130.9). From the Stage-Discharge curve, this would require a discharge of about 12,900 cfs.

Peak failure outflow = normal outflow + breach outflow

Normal outflow: 12,900 cfs.

Breach outflow. $Q_{p_1} = \frac{8}{27} W_b \sqrt{g}\, y_0^{3/2}$

y_0 = height of water surface above tailwater. Anderson Nichols (ANCO's) FIS work of 1977 uses a 50 year flow of 11,900 cfs and a 100 year flow of 12,500 cfs. These give a tailwater .9' and 1.1' above the spillway crest, respectively on HEC-2 runs. We will assume a tailwater 1.1' above, so y_0 = 7.0' for Q = 12,900 cfs.

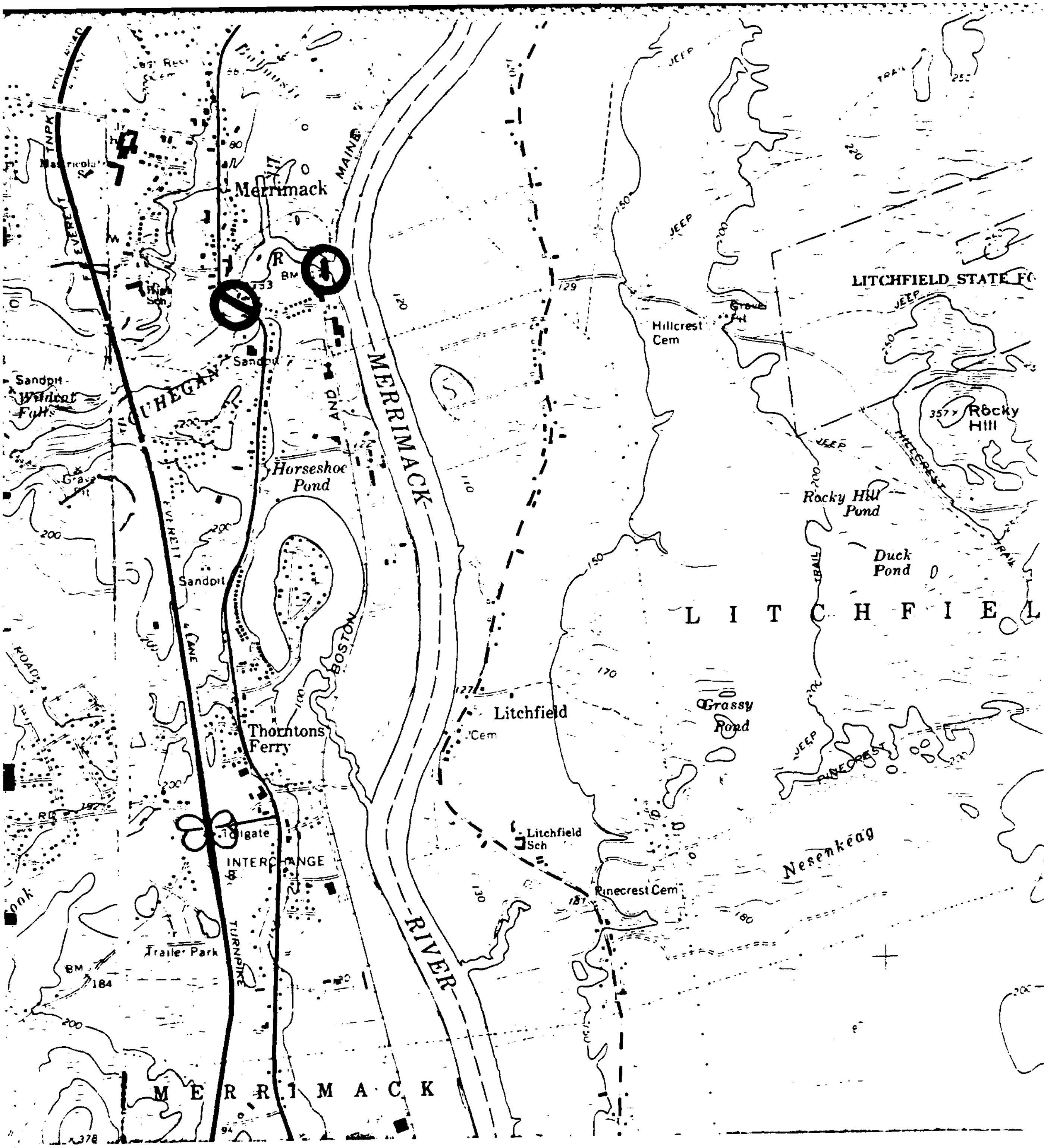
W_b = width of breach ≤ .4 (dam width)

W_b = .4 (145) = 58'

so $Q_{p_1} = \frac{8}{27} (58) \sqrt{g} (7)^{3/2}$ = 1810 cfs

So peak failure outflow = 14,700 cfs.

The Route 3 Bridge immediately downstream of the dam would receive the full failure outflow of 12,850 cfs. The bridge easily passes the ANCO 100 flow of 12,500 cfs (HEC-2 gives maximum stage 6.6' below low



DOWNSTREAM FLOOD HAZARD AREAS

MERRIMACK VILLAGE DAM

SCALE: 1:24,000

LOCATION 1 = Railroad Bridge

1 mile

there), and so would probably pass the 14,700 cfs flow.

It seems clear that, at flows high enough to present a threat of dam failure, failure would have little impact on downstream flooding. The only structure besides the Highway 3 Bridge downstream of the dam is the Boston and Maine Railroad Bridge at the mouth of the Souhegan. The small increase in flow from dam failure and the significant attenuation offered by the large channel of the Souhegan make damage to this structure from dam failure unlikely. Again, failure of Merrimack Village Dam would cause little or no increase in damage.

The plot on p. 8a of stage versus flow 365' downstream of the dam is based on ANCO's HEC-2 run. There is a wall on the south bank of the Souhegan about 14' above the invert. Beyond this wall is a factory and much of Merrimack Village. At Q=12900 cfs (just before overtopping) the water is some 24' above the channel invert, 10' above the wall. This would probably cause significant damage to factory and other structures. The peak failure outflow of 14,700 cfs would increase the water surface elevation by about 2 feet, to 26 feet above the channel invert & 12 feet above the wall. This would not be a significant increase to the extent of flooding, and would pose little hazard of loss of life.

165 Dam Safety; Merrimack Village Dam, #4 TCC, 1-30-79 p.9

Test Flood Analysis

Size classification: small

Hazard classification = low

The hazard classification is low because failure of Merrimack Village dam would cause little or no increase in downstream flooding.

Test analysis flood: 50 yr. to 100 yr.

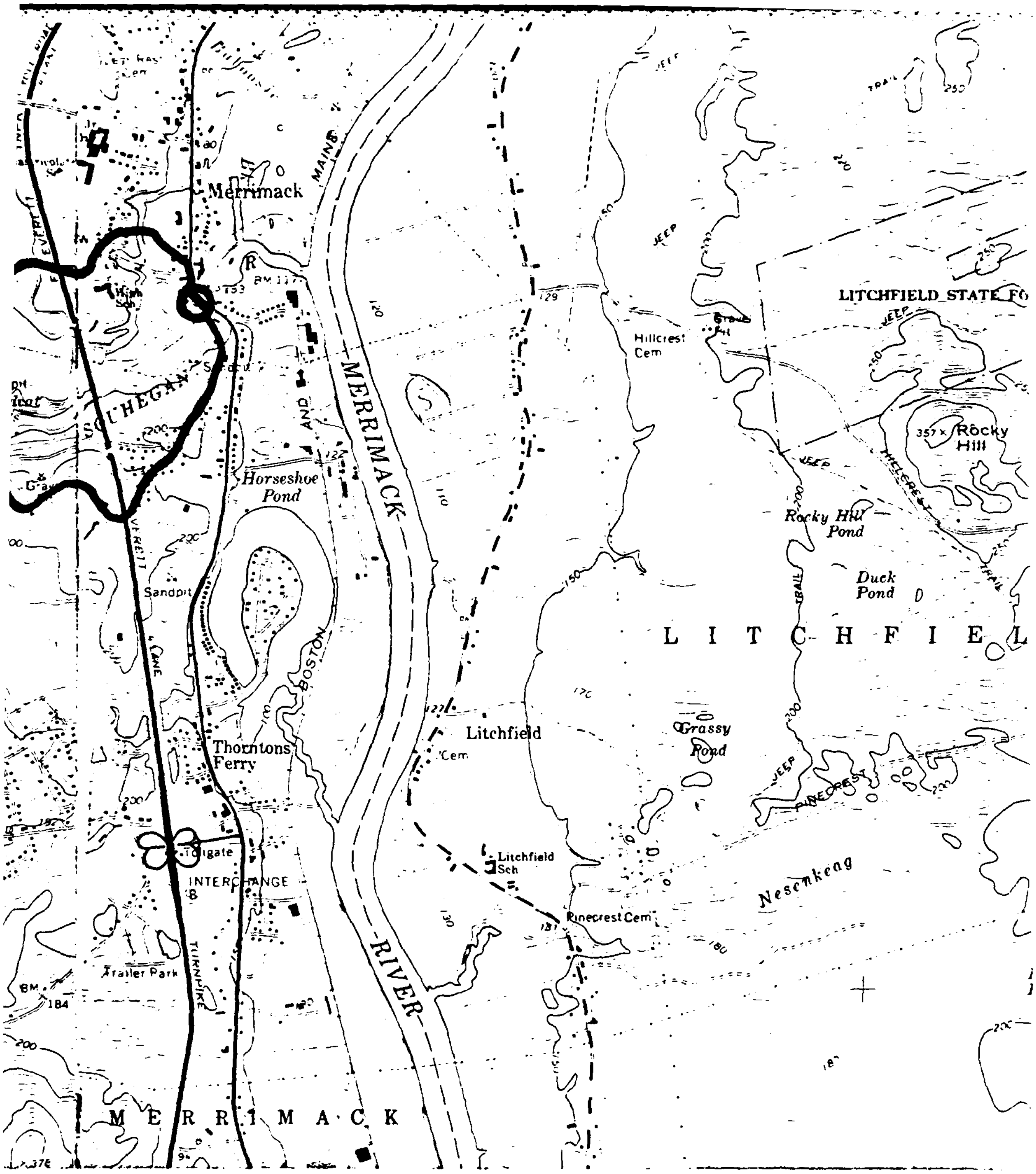
ANCO FIS work produced 50 and 100 year flows at Webster Dam:

Recurrence Interval	Flow (cfs)
50	11,900
100	12,500

It is worth noting that the peak historical flow USGS gage 01094000, about 1 mile upstream of the dam, is about 16,900 cfs on March 19, 1936 (The gage has ~ 40 years of record). (See note, p. 11)

Due to the pond's small surface area (~12 acres) & the large flows, storage would not significantly affect peak flows. The drainage area is shown on p. 10, and a storage-elevation curve on 10a

Recurrence Interval	Flow	elevation	h (over spillway) (from Stage-Discharge)
50	11,900	130.5	7.7
100	12,500	130.7	7.9
Peak historical	16,900	132.2	9.4

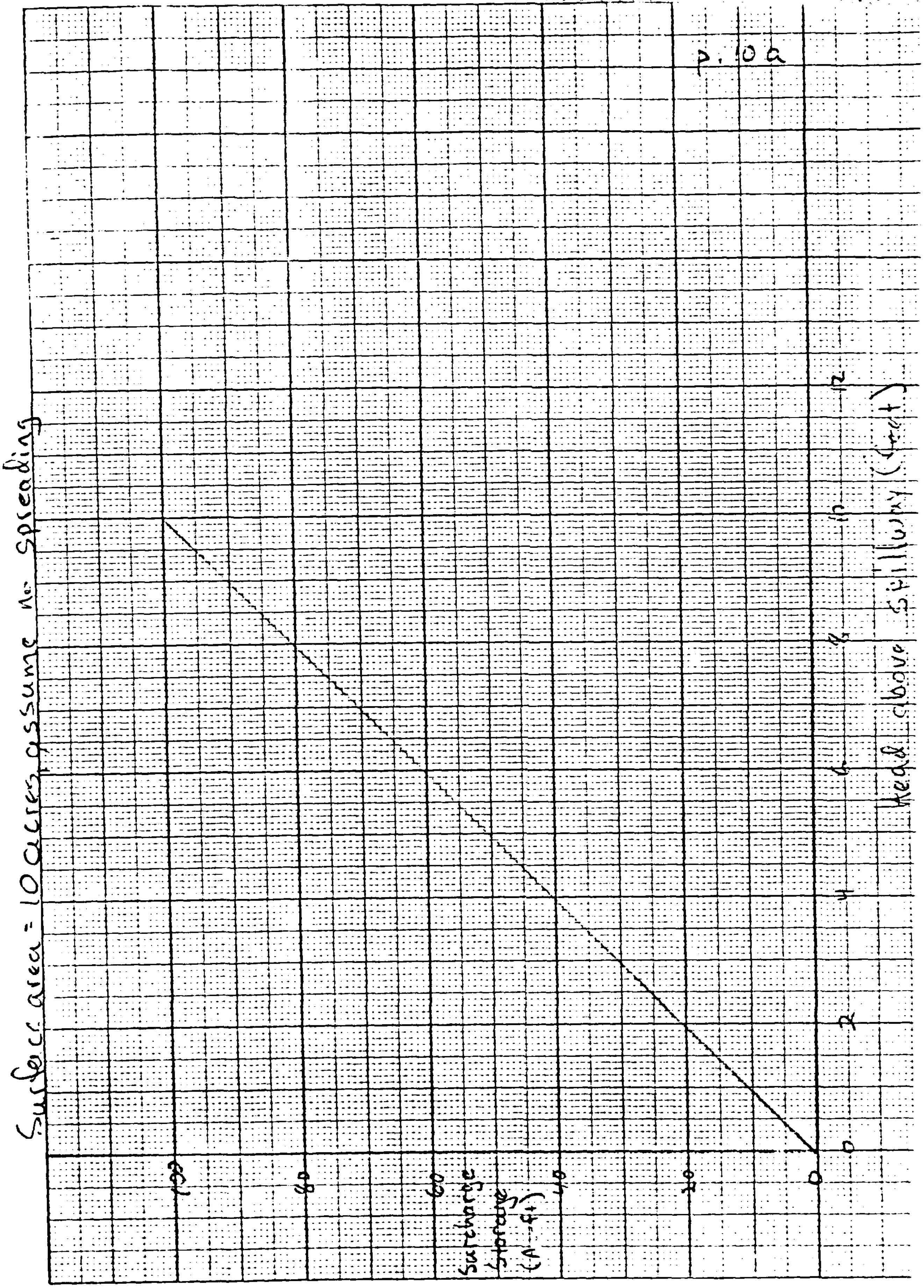


LOCATION MAP

MERRIMACK VILLAGE DAM

SCALE 1:24,000

1 mile


Surface area = 10 acres, assume no spreading
Head above Spillway (feet)
0
2
4
6
8
10
12
Surcharge Storage (A-ft)
0
20
40
60
80
100

165 Dam Safety Merrimack Village Dam, #NH 706, 1-30-79, p.1

It is not know what the actual height over the dam in the 1936 storm was. The dam did pass the flow without failing.

Note: One reason that the discharge of record exceeds the one hundred year flow is that "High flow slightly affected by retarding reservoirs since 1963" (USGS Water Resources Data)

APPENDIX E

INFORMATION CONTAINED IN THE

NATIONAL INVENTORY OF DAMS

STATE	NUMBER	DIVISION	STATE	COUNTY	DIST.	STATE	COUNTY	DIST.	NAME	(NORTH)	(WEST)	DAY MO YR
NH	115	NED	NH	011	01				MERRIMACK VILLAGE DAM	4251.6	7129.6	21FEB79

POPULAR NAME	NAME OF IMPOUNDMENT

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	05	SOUHEGAN RIVER	MERRIMACK	0	17000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)
PGGRCI	1907	O	21	21	170	85

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	N	21FEB79

REMARKS
1=NH15601 21=CONCRETE 22=REBUILT 1916 1934 25=NONE

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
3	180	U	145	12900												

OWNER	ENGINEERING BY	CONSTRUCTION BY
PENNICHUCK WATER WORKS		

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RES BD	NH WATER RES BD	NH WATER RES BD	NH WATER RES BD

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
GOLDBERG ZOINO DUNNICLIFF ASSOC	31OCT78	PUBLIC LAW 92-367

REMARKS

END

FILMED

8-85

DTIC